



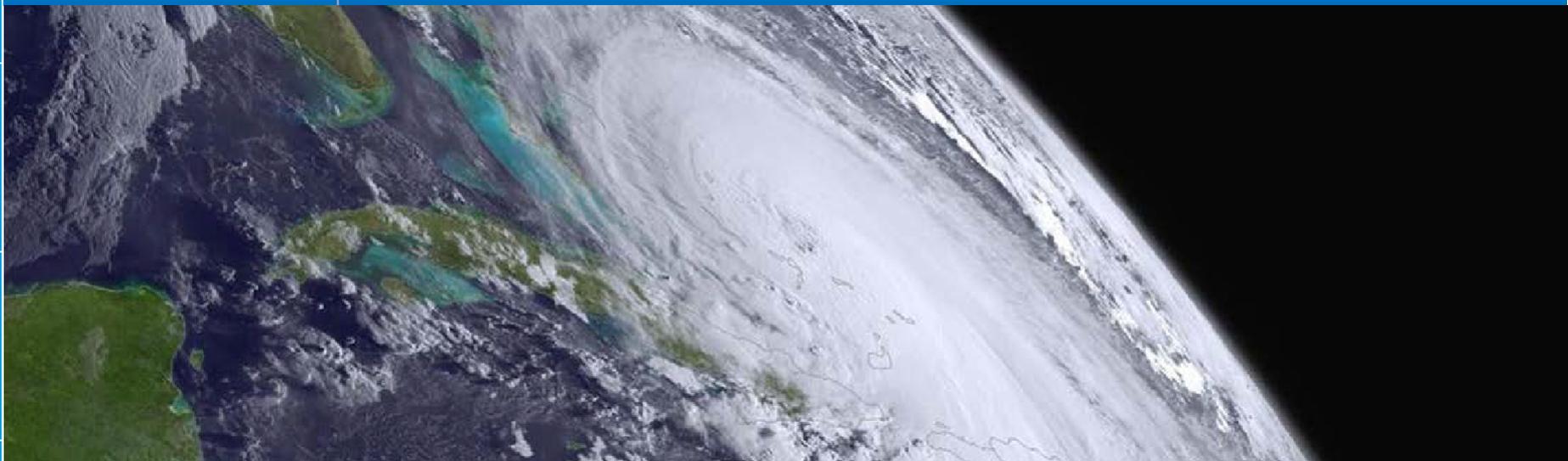
# The Earth Prediction Innovation Center (EPIC)

Overview Presentation by Bill Lapenta

EPIC Community Workshop

6 August 2019, Boulder CO

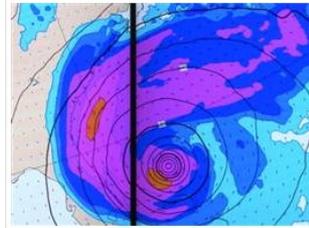
# NOAA



# Outline

- **Problem statement—why we are here**
- **EPIC defined in Public Law**
- **Investment areas**
- **FY19 Activities**
- **Workshop outcomes**

# Hurricane Sandy (2012) Raises Public Awareness of Modeling.....



Nightly News | March 08, 2013

## European weather forecasts superior to US models

The predictions from European computer models, which have 10 times the computing ability of the National Weather Service, have increasingly become more accurate than our models with the starkest example being Hurricane Sandy. NBC's Al Roker reports.

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## Capital Weather Gang

The inside scoop on weather in the D.C. area and beyond



The Washington Post Weather website

Jump to CWG's Latest Full Forecast

Outside now? Radar, temps and more: Weather Wall

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AT A GLANCE

Tue	Wed	Thu
54   70	53   75	58   78
Fri	Sat	Sun
20% 60   81	30% 63   80	20% 62   77

Posted at 11:24 AM ET, 03/08/2013

## To be the best in weather forecasting: Why Europe is beating the U.S.

By Richard B. Rood\*

The superior performance of the European GFS model, in high impact storms affected Snowquaster - has raised the question: good? Guest contributor Richard Rood

October 28, 2012, 8:17 PM

## Why America Has Fallen Behind the World in Storm Forecasting

Article | Comments (34)

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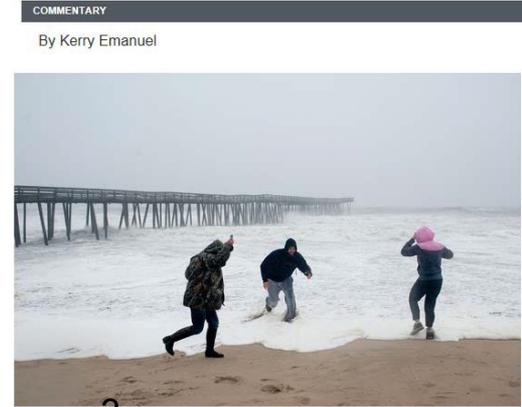
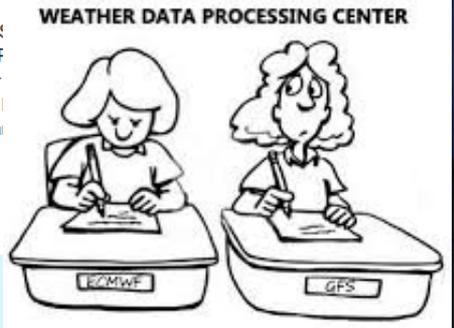
## Cliff Mass Weather Blog

Monday, February 11, 2013

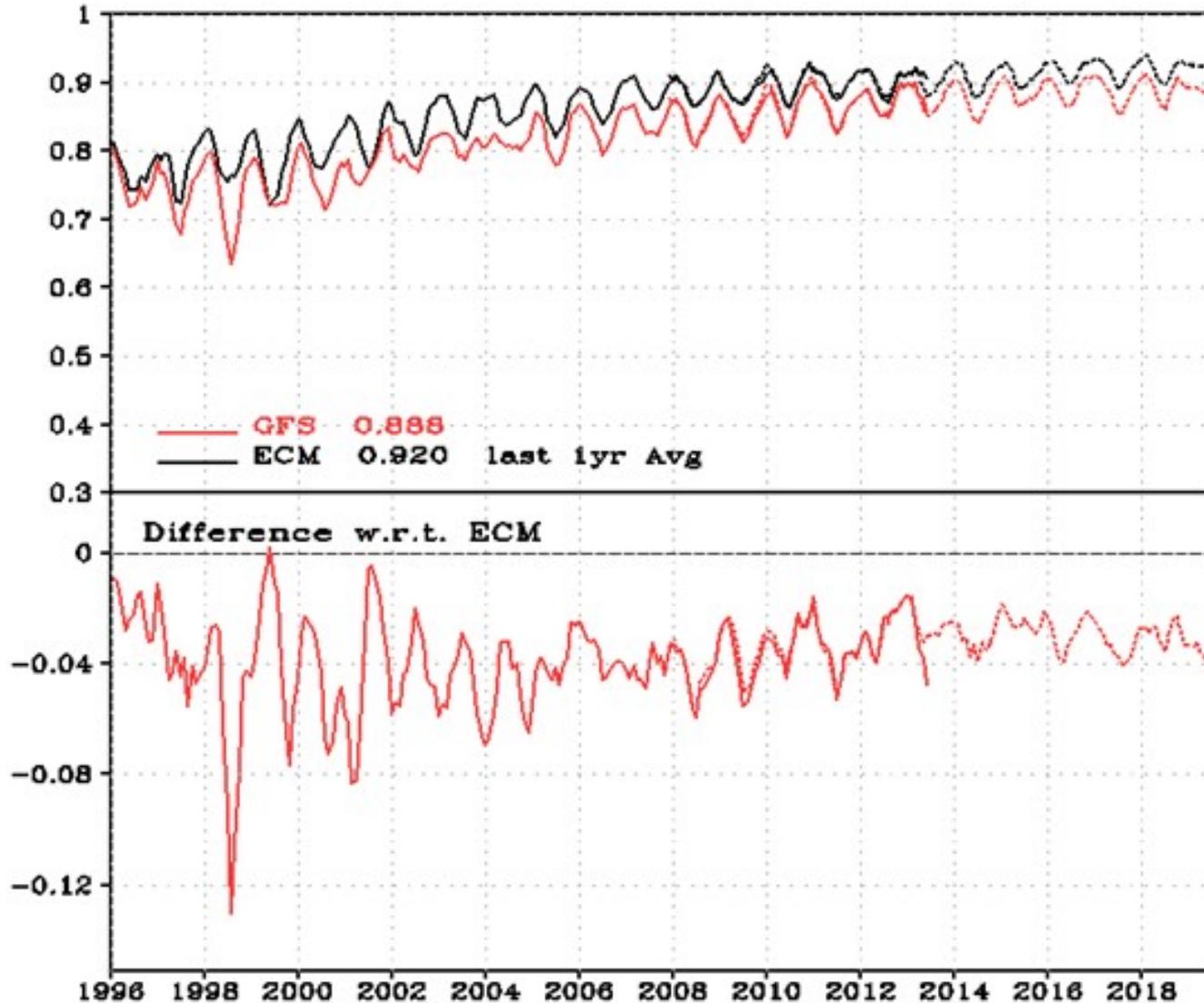
### The U.S. Weather Prediction Computer Gap

It happened again.

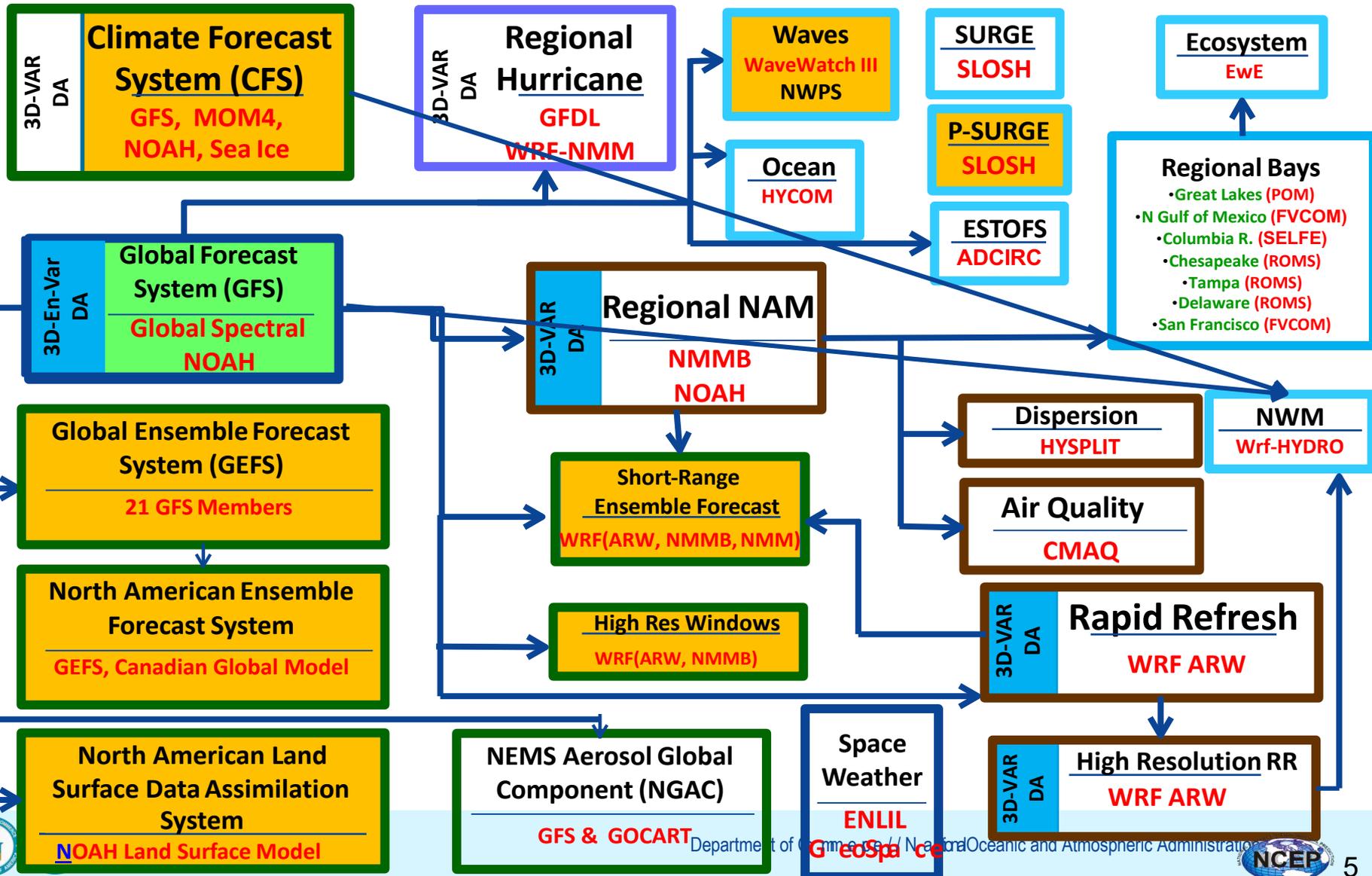
A major storm hit the northeast U.S. the European Center for Medium Forecasting illustrate, take a look at the 120-hr models valid at 4 PM PST Friday. solid lines, isobars, lines of constant



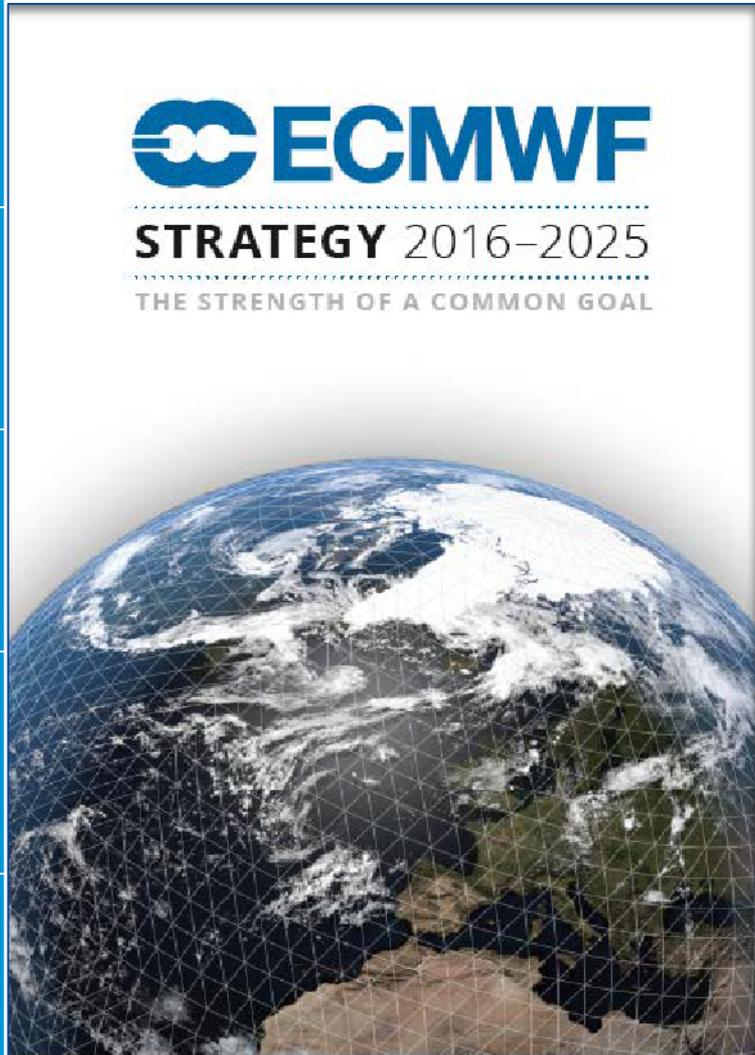
# Day-5 500mb AC Northern Hemisphere 3-month running mean (1996-2018)



# The Production Suite: An Example of Complexity



# THE STRENGTH OF A COMMON GOAL.....



- Attractive working terms and environment to attract and retain the required talent
- ECMWF inspiring and attracting international scientific and computing collaboration across the Member States and beyond
- A powerful, energy-efficient and resilient infrastructure, including a high-performance computing facility, systematically seeking to minimise its environmental impact
- Scalable and efficient modelling and processing codes that encompass a comprehensive Earth system approach

# Can the U.S. Modeling Community identify and achieve a common goal?



## ARTICLES

### THE UNCOORDINATED GIANT

Why U.S. Weather Research and Prediction  
Are Not Achieving Their Potential

BY CLIFFORD MASS

Although the U.S. meteorological community has made significant strides in weather prediction, more closely coordinated research and operations would accelerate progress.

**T**here can be little doubt that weather prediction in the United States has improved considerably over the past several decades. Synoptic-scale numerical prediction models, such as the National Centers for Environmental Prediction's (NCEP's) Global Forecast System (GFS), are producing far more

tional Doppler radar system [Weather Surveillance Radar-1988 Doppler (WSR-88D)], even with substantial gaps, has afforded improved prediction of convective storms and better short-term precipitation forecasts over much of the nation. Buying satellite data from high-resolution imagery and water vapor/cloud-track



# Weather Research and Forecast Innovation Act: EARTH PREDICTION INNOVATION CENTER (EPIC) (January 2019)



**Goal: To advance numerical guidance skill, reclaim and maintain international leadership in NWP, and improve the research to operations transition process**

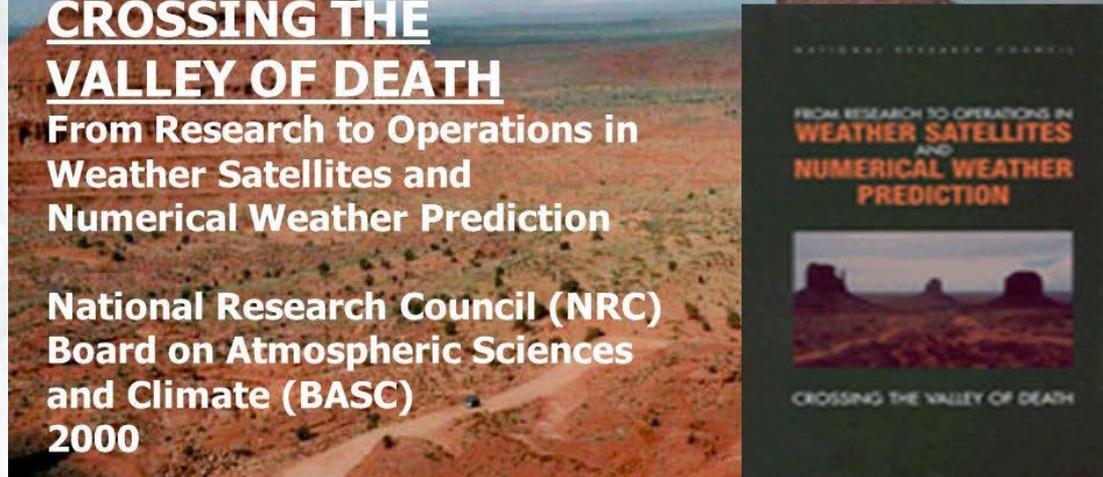
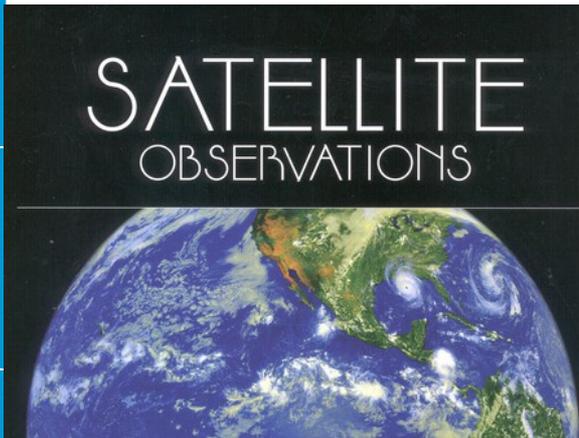


- 
- Leverage the weather enterprise
  - Enable scientists and engineers to effectively collaborate
  - Strengthen NOAA's ability to undertake research projects
  - Leverage existing resources in NOAA
  - Create a community global weather research modeling system
    - **Accessible by the public**
    - **Computationally flexible**
    - **Utilizes cost-effective, innovative strategies and methods, including cloud-based computing capabilities, for hosting and management of part or all of the system**
- 

# Transition of Research into NOAA Operations



It's not a new problem.....



# Case in Point:

## Developmental Testbed Center (DTC) (Established in 2003-USWRP)

**Mission: Facilitate the interaction & transition of NWP technology between research & operations**

- **Community: Visitor Program, Workshops, Newsletter**
- **R2O: Perform T&E on promising NWP innovations for possible operational implementation**

### **Auxiliary functions:**

- **Verification software: MET development**
- **O2R: Support operational NWP systems to the community (tutorials, documentation, datasets for HWRF, UPP, GSI, EnKF)**
- **Infrastructure: Code Management, Change Review Boards**



# Fundamental Questions:

- How will EPIC accelerate the rate of innovation transition into NOAA operational NWP?
- What environmental factors have changed?
  - Technological
  - Organizational
  - Cultural

# External Review Committee for NCEP Modeling Suite (2015)

## RECOMMENDATIONS

- Reduce complexity of the NCEP Production Suite
- Create a unified collaborative strategy for model development across NOAA
- Leverage the capabilities of the external community
- Continue to enhance High Performance Computing capabilities
- Execute strategic and implementation plans based on stakeholder requirements

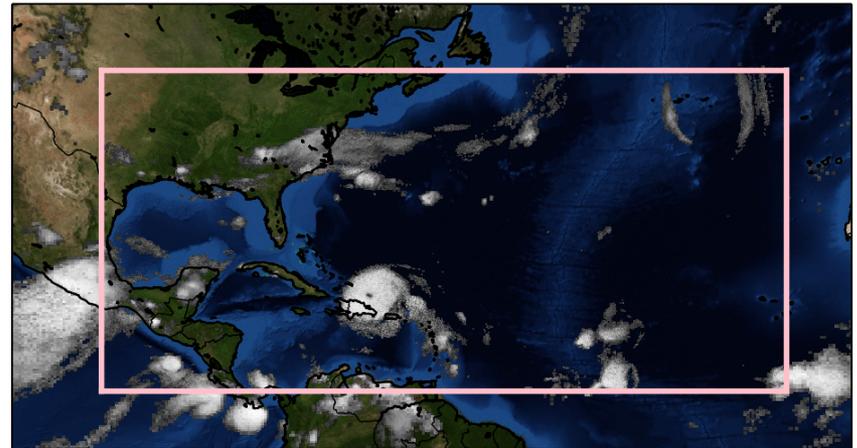


[http://www.ncep.noaa.gov/director/ucar\\_reports/ucacn\\_20151207/UMAC\\_Final\\_Report\\_20151207-v14.pdf](http://www.ncep.noaa.gov/director/ucar_reports/ucacn_20151207/UMAC_Final_Report_20151207-v14.pdf)

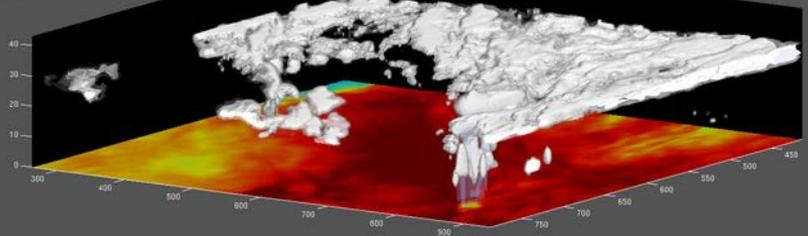
# Next Generation Global Prediction System (NGGPS)

- Identify and adopt an advanced non-hydrostatic dynamic core and evolve it to meet operational needs for the foreseeable future
- Evidence based decision making process to ensure scientific integrity and excellence
- Enhanced O2R2O process and a unified and efficient infrastructure for community engagement and rapid transition of advanced research into operations
- Seamless solutions for tropical weather and climate in a unified global-to-local-scale modeling framework

2005-09-01 01:30:00



20-May-2013  
20:20:00



High-resolution nested grid simulations using  
HiRAM and Finite Volume 3 (FV3)



# The Unified Forecast System (UFS)

- A comprehensive, community-developed Earth modeling system, designed as both a research tool and as the basis for NOAA's operational numerical guidance systems
- Configurable into multiple applications that span local to global domains and predictive time scales from less than an hour to more than a year
- A *unified* system because the applications within it share science components and software infrastructure
- A paradigm shift that will enable NOAA to simplify the Production Suite, to accelerate use of leading research, and to produce more accurate forecasts for the U.S. and its partners

# The NOAA-NCAR MOA

## Co-development of a Common Model Infrastructure

Letter of Intent for collaboration between NCAR, NWS and OAR signed July 28, 2017

- “to develop a Memorandum of Agreement (MOA) that will describe how both organizations will work collaboratively toward the design and construction of a community unified modeling infrastructure. “

- Identified benefits include

- Synergies
- Common repositories
- Access to NOAA operational models

- Unification for inter-component, intra-component coupling and common workflow development
- Unified testing to assure code is robust and performs as expected
- Unified model validation and expansion to application for fully coupled systems
- Github based repositories for all infrastructure
- Modeling support; leveraging, creating if necessary, or adapting support capabilities at NCAR and DTC

# EPIC Alignment Workshop

*Boulder CO 6-7 March 2019*

## Purpose:

Assemble NOAA modeling Principals (labs, centers, programs, line offices) to obtain alignment and explore options how EPIC will enhance existing model development and transition processes within the agency



## Outcome:

A NOAA vision paper describing the roles and responsibility of EPIC required to establish a more efficient R2O2R process for operational NWP applications of the UFS.

## Schedule:

Paper completed 15 April with briefing to ASEOP and AA's on 3 May 2019

## Community Engagement:

RFI released 7 June, closes 11 July  
Community Workshop 6-8 August

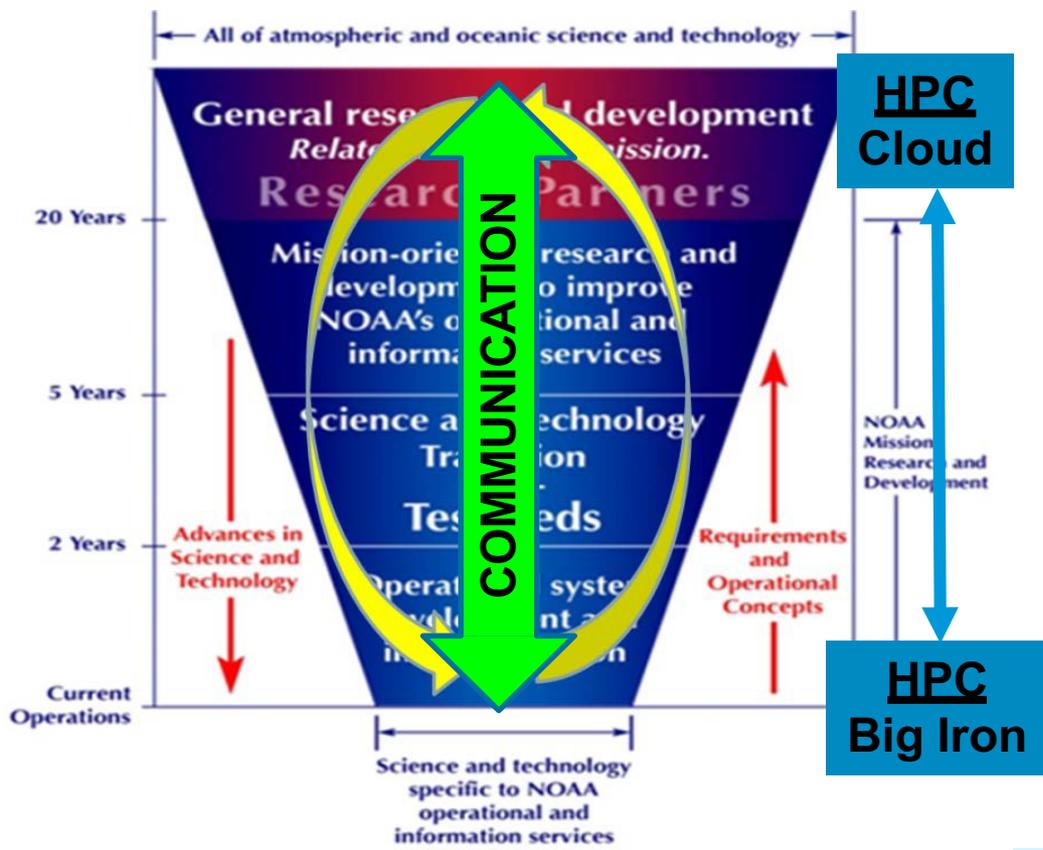


# Core Investment Areas Identified at the EPIC Alignment Workshop

- **Software engineering**
- **Software infrastructure**
- **User support services**
- **Cloud high performance computing**
- **Scientific innovation**
- **Management and planning**
- **External engagement and community**

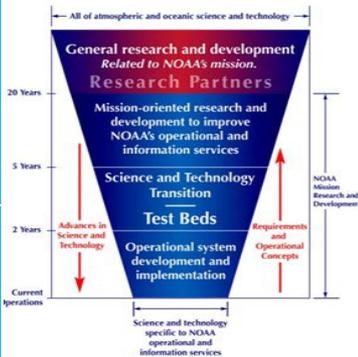
# Building blocks to achieve the goal of accelerating innovation into operations...

Leadership (Mission)  
 Programs (Strategies & \$\$)  
 Labs/Centers (People & Execution)

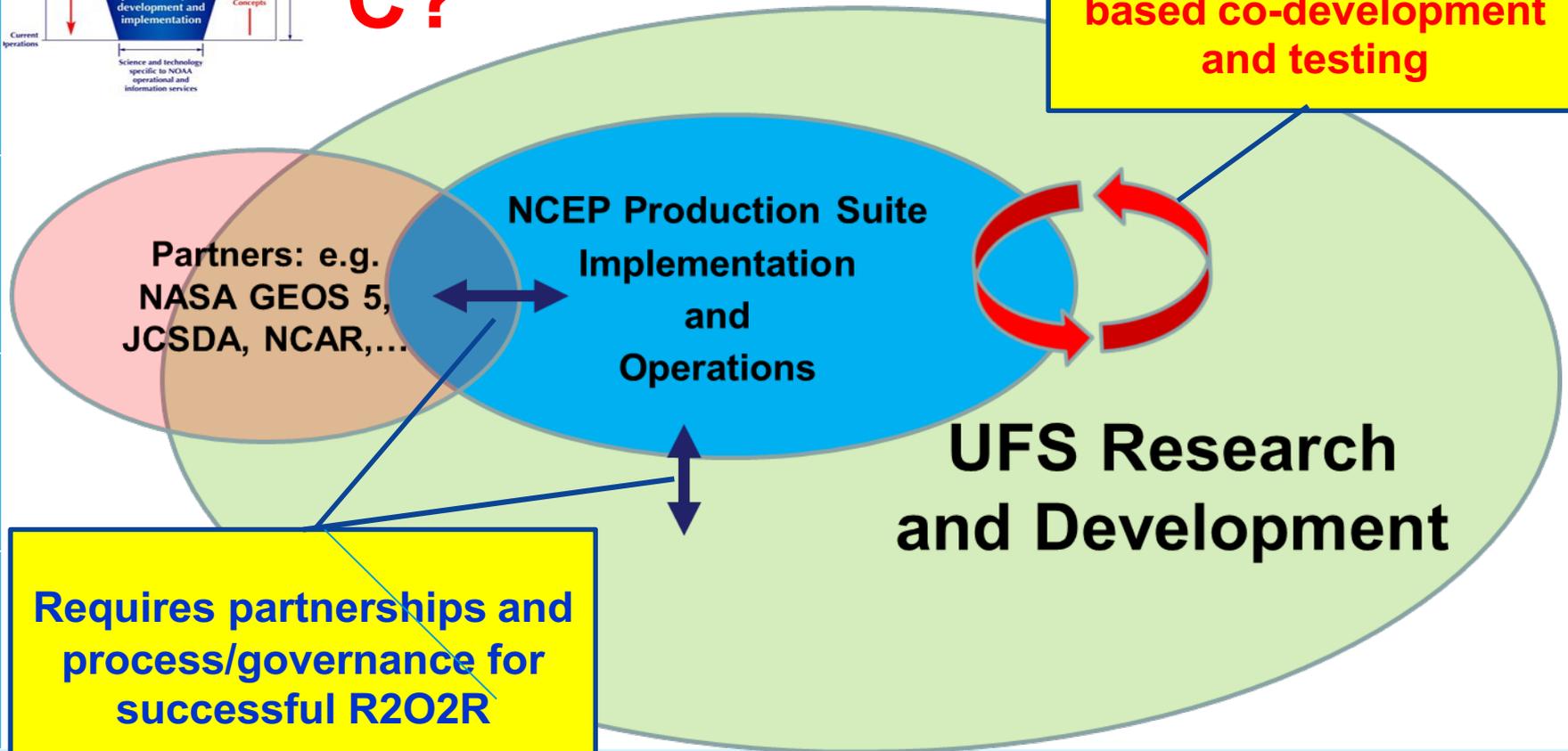


# Unified Forecast System and Community Modeling

C?  
C?  
C?  
C?



**Infrastructure required to enable community-based co-development and testing**



**Requires partnerships and process/governance for successful R2O2R**

# Why EPIC will deliver **MORE** innovative operational outcomes?

## 1) Community modeling capability based on the UFS:

- NOAA and community identifies scientific priorities, test plans, validation and verification metrics for NOAA operational UFS applications
- Enables co-development between research and operational scientists
- Community can run/test operational configurations
- Partner agencies can contribute common components leveraging co-development

## 2) High Performance Computing:

- Explore cloud HPC for R&D purposes (NOAA Cloud Vision)
- Agile development capacity (run experiments in parallel vs serial)
- Mitigates problematic access to NOAA HPC assets
- “Big iron” still required!!! (operations and R&D)

# Why EPIC will deliver **MORE** innovative operational outcomes?

## 3) Connecting Scientists:

- UFS governance provides communication continuum across depth of funnel
- OAR-NWS scientist exchange program (Weather Act)
- Innovation and rapid prototyping capability

## 4) Interagency Involvement

- Identify return on investment for agencies
- Use existing governance within OFCM?

## 5) Connect mission, programs (\$\$) and people (outcomes)

# Building the EPIC Program

- **The OAR Office of Weather and Air Quality (OWAQ) is responsible for executing the EPIC program**
- **The OWAQ Director will have ultimate oversight**
- **Activities will be managed by the current OAR Program Manager for NGGPS (DaNa Carlis)**
- **FY20 President's Budget includes \$15M for EPIC**

# FY19 EPIC Core Investment Areas:

- **Management and planning**
  - **Build program in OAR/OWAQ**
- **Software engineering & infrastructure**
  - NCAR-NOAA MOA for co-development of a common model infrastructure spend plan development and UFS Strategic Implementation Plan (SIP)
    - **FY19 OWAQ USWRP (1.1M) & JTTI (\$5.4M)**
    - **FY18 & FY19 Disaster Supplementals**
    - **FY19 DTC & JCSDA AOP**
- **External engagement and community**
  - **Request for Information (RFI)– 7 June – 10 July**
  - **Community Workshop (6-8 Aug) Boulder CO**
  - **NOAA to consider Request For Proposals (RFP) ~ Fall 2019**
- **Cloud high performance computing**
  - **Global Model Cloud HPC Pilot Project**
  - **NOAA Cloud Strategy (corporate)**



# Why are we here?